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ABSTRACT

A study was conducted to test a model that conceives of long term memory as a propositional network of ideas made up of knowledge clusters and related subclusters. After two pilot studies suggested that recall order of ideas was unrelated to organization, the study investigated whether units of main and supporting ideas produced during organization cohered during recall. Subjects were 18 college undergraduates randomly assigned to two equal groups. On the first day of the experiment, all subjects generated 20 ideas on how college differs from high school. Subjects in one group then outlined their ideas in sequence using two orders, main ideas and supporting ideas; subjects in the other group were asked to write a text from the ideas they had generated. Twenty-four hours later all subjects were instructed to number their papers from 1 to 20 and to recall their original ideas. Analysis of the data once again indicated that recall order was unrelated to both generation and organization order. Major ideas were recalled more frequently than supporting ideas for both groups of subjects, and those who wrote texts recalled more ideas in all. These results are consistent with the cluster hypotheses of the model under investigation. (JL)

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IDEA ORGANIZATION AND IDEA RECALL

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The effects of organizing ideas to produce a written text are investigated and discussed in terms of models of long term memory (Raijmakers & Shiffrin) and of composition (Flower & Hayes). Subjects generated ideas relevant to a specific topic on Day 1. Then they organized their ideas and wrote a coherent text on the topic. Twenty four hours later, subjects tended to free recall groups of ideas that had been clustered together during the text organization phase of the experiment, consistent with the time locking cluster of Raijmakers and Shiffrin.

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Abstract

The effects of organizing ideas to produce a written text are investigated and discussed in terms of models of long term memory (Raijmakers & Shiffrin) and of composition (Flower & Hayes). Subjects generated ideas relevant to a specific topic on Day 1. Then they organized their ideas and wrote a coherent text on the topic. Twenty four hours later, subjects attended to free recall groups of ideas that had been clustered together during the text organization phase of the experiment, consistent with the time locking cluster hypotheses of Raijmakers and Shiffrin.

Idea Organization and Idea Recall

Writing draws upon many of the same psychological processes involved in reading and text comprehension (Kintsch & van Dijk, 1978). Notably, both reading and writing involve the use of knowledge stored in long term memory. The writer draws ideas relevant to his/her topic from long term memory. Similarly, the reader draws upon relevant knowledge to construct a frame suitable for comprehending text. In the study that follows, we investigate changes in the organization of ideas in long term memory as a result their retrieval and use in various writing-related activities.

One of the most widely accepted and empirically well-documented models of long term memory was developed by Raijmakers and Shiffrin (1981). In their model, long term memory is conceived as a propositional network of ideas. It is organized in the sense that certain propositional nodes are related to one another, i.e., stored in proximity to one another. Within a knowledge cluster, there may exist many subclusters. This general structure of knowledge clusters and related subclusters is revealed when subjects freely generate ideas. It is our intent to investigate how the relationships among items within a subcluster and between subclusters change, after generation as a result of the organizational processes involved in writing.

Flower and Hayes (1979) have developed a analysis of writing that sets forth certain expectations about how the writing task should affect permanent memory structures. In their model, the writing process is conceived as three major subprocesses with distinct psychological characterisitics. The subprocesses are planning, translating, and editing. The planning process is subdivided into three components: generating and organizing ideas, and goal setting (the latter is a control process that

decides when to schedule generating, organizing, translating, or reviewing). The generating process is initiated by retrieval cues. In writing, the first memory probe is provided by information about the topic and the intended audience. As items are retrieved, associative chains are formed. Associative links are broken whenever something not useful to the writing task is retrieved. Generally, the ideas retrieved from long term memory are fragmentary and disconnected. The subprocess of organizing thus becomes important in determining the final written product.

Organizing involves hierarchically arranging goals or particular aspects of the topic to be discussed. These goals have subgoals or subtopics and supporting arguments. Flower and Hayes describe five elementary operators that work to organize the writer's goals -- identify first or last topic; order with respect to previous topic; find subordinate topic; find superordinate topic; and identify category. These operators are believed to be primarily responsible for transforming the generated ideas into written text.

While other processes are also involved in constructing a written text, we concentrate here on the subprocesses of generating and organizing. Our rationale is based on Flower and Hayes' predictions that the associative connections revealed in the generating stage will appear in the same sequence later unless an organizing process intervenes. Thus, we attempt to test whether the organizing subprocess affects items stored in permanent knowledge structures by assessing whether a later recall task is influenced by an intervening organizational task.

We conducted two pilot studies to determine whether recall order was more closely correlated with generation order or order of subsequent organization. In Study 1, subjects generated 12 ideas on a given topic and rank ordered them for importance to an article that they might write about

that topic. Twenty-four hours later they free recalled as many ideas as possible. Then subects ordered their ideas to form a coherent text outline three times independently. The results of Spearman rank order correlations revealed that recall order was uncorrelated with both generation and organization orders.

Study 2 was similar to Study 1 except that subjects generated ideas, rank ordered them and performed a free recall task during the same session. Again, order was unrelated to recall order although free recall order was negatively correlated with generation order.

As a result of these pilot findings, we decided to evaluate possible changes in long term memory in a different way. As the order of ideas recalled seemed unrelated to organization order, we investigated whether units of main and supporting ideas produced during organization cohered during recall, as might be suggested by the cluster/subcluster hypothesis of Raijmakers and Shiffrin.

Method

Subjects

Eighteen undergraduate students from the University of Colorado served as subjects for this experiment, thus fulfilling course requirements. Two experimental groups were formed by randomly assigning nine subjects to a group.

Procedure

On Day 1 (Generation), all subjects generated 20 ideas on how college differs from high school. Each idea was written on a numbered index card to reflect the generation order. Subjects in Group 1 (Organization) then

arranged their ideas in sequence using two orders, main ideas and supporting ideas. They were instructed to develop a coherent outline of a text, using only the ideas generated on the preceding day. This outline was then written on a sheet of paper. Subjects in Group 2 (Writing) were asked to write a text using the ideas they generated. The index cards were then used to identify the idea numbers corresponding to the texts of Group 2.

Subjects returned for a third session 24 hours later and were instructed to number their papers from 1-20 and recall their original ideas.

Results

As we were interested in the effects of organization on memory, our first analysis correlated generation and organization or writing (Day 1) orders with the order of ideas produced in recall (Day 2). Spearman rank order statistics were obtained for each subject and averaged across subjects in each group. The results of our pilot studies were replicated. There were no statistically significant effects for either group of subjects $r = .136$ and $r = .145$ for Groups 1 and 2 respectively. Recall order appears to be unrelated to both generation and organization order.

We then looked at recall probabilities for major topics and supporting arguments as identified either in outlines (Group 1) or written products (Group 2). Major ideas (93.5%) were recalled significantly more frequently than supporting ideas (77.6%) for both groups of subjects, $F(1,16) = 10.47$, $p < 01$. In addition, a significant group effect was obtained, $F(1,16) = 10.21$, $p < 01$. Subjects who wrote texts recalled more ideas in all (90.5%) than subjects who merely ordered their ideas (80.7%). This group

than subjects who merely ordered their ideas (80.7%). This group difference is reflected in both the percentage of main ideas and supporting arguments recalled, as depicted in Table 1.

Insert Table 1 about here

Further analyses were conducted to determine whether units produced in the organization stage were preserved during recall. Units consisted of a main idea and its supporting ideas. The average unit consisted of 4.5 ideas (one main idea and 3.5 supports) and did not vary between groups. Thus, we examined whether the ideas composing a unit created during the organization stage were recalled together during the recall stage. Overall, only 80% of the ideas used during the organization phase of the experiment were recalled. To determine whether these ideas were clustered as they were during organization, we calculated the percentage of ideas recalled together in each unit produced during organization. These percentages were then averaged for each group. Groups did not significantly differ in the percent of ideas cohering to the organization grouping (Group 1 = 55.4%, Group 2 = 58.0%). Of the ideas recalled, 57.7% preserved their organization unit grouping 24 hr. later. Many of the larger units ($\bar{x}$ size = 7.2 ideas) were recalled in two separate clusters. However, only the cluster containing the originally identified main idea was used in calculating the above percent of unit coherence.

Discussion

Raijmakers and Shiffrin (1980) account for the free recall of items from long term memory in terms of retrieval strategies that provide a

certain structure for the items produced. Retrieval is presumed to operate on long term memory on a one unit or cluster at a time basis. Which unit is retrieved via a particular strategy may vary, however, from moment to moment even when the same retrieval cue is utilized. In the present experiment, initial generation reveals the inter-item or cluster relationships in long term memory as it is structured in subjects at the outset of this experiment.

As a subject creates a coherent text, certain items retrieved from long term memory are input into short term memory where they are rehearsed and recoded. According to Raijmakers and Shiffrin, items recoded together in short term memory are then re-input as units to long term memory. These units created in short term memory do not replace the initial structure. Rather, they enter long term memory as another copy of the same information. Which copy is most accessible at any given point in time is indeterminate in the Raijmakers and Shiffrin model except when subsequent retrieval is closely time-locked to unitization in short term memory.

Results of the present experiment are consistent with the Raijmakers and Shiffrin model in the sense that free recall subsequent to unitizing items in short term memory is as much or more consistent with how the items were reorganized than it is with intitial free recall or generation. The results further reflect positively on the suggestion of Flower and Hayes (1979) that the organization subprocess of writing results in marked changes in associative connections in long term memory. The final recall of items corresponded more with item organization produced during writing than with initial free recall. That is to say, subjects tended to recall items in the units created while organizing ideas to form a written text.

The time locking hypothesis of Raijmakers and Shiffrin is an important consideration that might distinguish their model from expectations based on

the postulates of Flower and Hayes. That is, as time is allowed to pass between the writing exercise and subsequent regeneration or free recall of items related to a particular topic, the correlation between initial and final free recall should increase. Final free recall should correlate better with the organization during writing if that free recall is taken close in time to the writing exercise. Correlation should decrease with the writing organziation and increase with the initial free recall structure as time passes, according to Raijmakers and Shiffrin. As the theory of Flower and Hayes is presently written, no similar expectation can be stated.

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Table 1

Group Differences in Recall

of Main and Supporting Ideas

	Ideas	
	Major	Supporting
Group 1	89.5	71.5
Group 2	97.8	83.8